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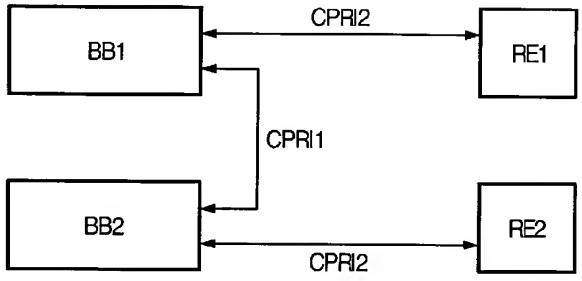
(54) UTILISATION MULTIPLE D'UNE INTERFACE STANDARDISEE DANS UN DISPOSITIF
(54) MULTIPLE USE OF A STANDARD INTERFACE IN A DEVICE

(57)

The invention relates to a device comprising at least one first unit (BB1, BB2), a first interface (CPRI) for transmitting data between the first unit (BB1, BB2) and a second unit (BB1, BB2) that is functionally identical to the first unit (BB1, BB2), and a second interface (CPRI) for transmitting data between the first unit (BB1, BB2) and a third unit (RE1, RE2) which is functionally different from the first unit (BB1, BB2). The first and the second interface (CPRI) are embodied such that a plurality of types of data can be transmitted, respectively. The two interfaces are specified according to the same standard.



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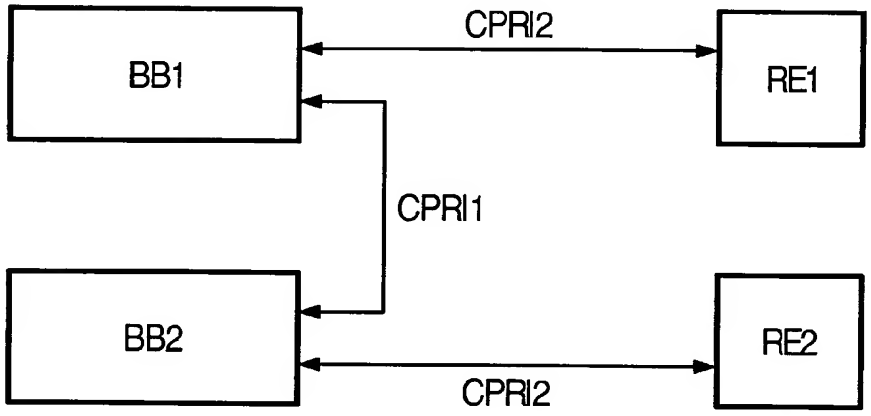


(57) Abrégé/Abstract:
The invention relates to a device comprising at least one first unit (BB1, BB2), a first interface (CPRI) for transmitting data between the first unit (BB1, BB2) and a second unit (BB1, BB2) that is functionally identical to the first unit (BB1, BB2), and a second interface (CPRI) for transmitting data between the first unit (BB1, BB2) and a third unit (RE1, RE2) which is functionally different from the first unit (BB1, BB2). The first and the second interface (CPRI) are embodied such that a plurality of types of data can be transmitted, respectively. The two interfaces are specified according to the same standard.

Abstract

The invention relates to a device comprising at least one first unit (BB1, BB2), a first interface (CPRI) for transmitting data between the first unit (BB1, BB2) and a second unit (BB1, BB2) that is functionally identical to the first unit (BB1, BB2), and a second interface (CPRI) for transmitting data between the first unit (BB1, BB2) and a third unit (RE1, RE2) which is functionally different from the first unit (BB1, BB2). The first and the second interface (CPRI) are embodied such that a plurality of types of data can be transmitted, respectively. The two interfaces are specified according to the same standard.

Description

Multiple use of a standard interface in a device

The invention relates to a device having a first interface for transferring data between a first unit and a second unit which is functionally identical to the first unit, and a second interface for transferring data between the first unit and a third unit which is functionally different from the first unit. The invention also relates to a method for operating such a device.

Interfaces are used for the connection between two or more units of one or more devices, wherein data can be transferred between the connected units via an interface. With reference to the physical layer, an interface can be implemented by means of a cable or a line, for example, via which data is transferred using electrical or optical transfer methods. An interface is defined inter alia by the transfer methods and transfer protocols which are used for communicating between the connected units. A transfer protocol is understood to mean an established method for the exchange of data between two units which are connected via an interface; a transfer protocol includes conventions comprising defined data formats and control procedures for the communication. Transfer protocols according to the OSI (Open Systems Interconnection) layered model are one example of a group of transfer protocols.

The structure or the definition of an interface, which might be specified e.g. according to a standard, is normally dependent on the nature of the units which are connected by the interface, and therefore it is not generally possible to connect indiscriminate units via a specific interface.

Various units which are connected together via suitable interfaces are also present in base stations of radio communication systems. Base stations normally comprise a plurality of units for baseband processing, wherein data for or from subscriber stations is processed in the entities for baseband processing. There are also send/receive units which modulate baseband data, said baseband data being supplied by the baseband processing, on carrier frequencies and send it to subscriber stations. The connection between a unit for baseband processing and a send/receive unit can be made e.g. via an interface according to the CPRI standard (currently: CPRI Specification V1.0 (2003-09-30), Common Public Radio Interface (CPRI); Interface Specification obtainable via http://www.cpri.info/).

Document EP 1 246 484 A2 describes a base station of a UMTS radio communication system. The analog signals are processed in high-frequency blocks and the digital signals are processed in baseband blocks. A plurality of HF blocks are combined into an HF board and a plurality of baseband blocks are combined into a baseband board. A connection line exists in each case between an HF block and a baseband block. The individual computing blocks of the baseband blocks are connected to each other via a high-speed interface.

In particular for the radio standard UMTS (Universal Mobile Telecommunications System), it might be necessary in the send direction to add data of a multiplicity of subscriber stations, said data possibly being processed by different entities for baseband processing, before it is transferred to the relevant send unit, or in the receive direction to distribute the data received by a send/receive unit over a

plurality of entities for baseband processing. In order to achieve this, one unit which carries out partial steps of the baseband processing in base stations is normally connected in star form to a plurality of units that are functionally different from the first-cited unit and carry out other partial steps of the baseband processing.

The invention addresses the problem of setting forth an efficient implementation of a device, e.g. comprising components of a base station in a radio communication system,

unit via interfaces.

This problem is solved by a device having the features in claim 1 and by a method having the features of a respective claim.

Advantageous configurations and developments are the subject matter of dependent claims.

The device according to the invention comprises at least a first unit. It has a first interface for transferring data between the first unit and a second unit which is functionally identical to the first unit, and a second interface for transferring data between the first unit and a third unit which is functionally different from the first unit. In this context, the first and the second interface are configured such that a plurality of different data types can be transferred in each case and that the two interfaces are specified according to the same standard.

The second and/or the third unit can be a component of the claimed device or of another device or of a plurality of other devices. The functional equality between the first unit and the second unit does not signify that these must necessarily be constructed in an identical manner, but rather that they can be used for solving reciprocally corresponding or analogous problems. In addition to the connection of the first unit to the second and third unit, there may be further connections of the first unit to further units which are functionally identical to or different from the first unit.

An interface is understood to mean a material connection, e.g. a cable or a line, between the first unit and the second or third unit. It is possible to transfer a plurality of data

types over the interfaces which are used in the invention, wherein different data types may vary e.g. in respect of their content and/or their source and/or in respect of their requirements for transfer via the interface, for example the necessary data speed or timing requirements relating to the transfer. It is possible either that the data types which can be transferred via the first interface differ from those which can be transferred via the second interface, or that these data types are identical. Both of the interfaces utilized in the invention are specified according to a standard, wherein a standard relating to an interface stipulates or at least offers a selection of e.g. transfer methods for the physical layer and/or transfer protocols for higher layers.

In a development of the invention, the standard provides for the transfer of the various data types using a time-division multiplexing method. The standard can additionally or alternatively provide for an optical and/or an electronic transfer method.

According to an advantageous configuration of the invention, the standard provides for an Ethernet protocol and/or an HDLC (High Data Link Control) protocol as a transfer protocol. It is possible for further protocols to be provided or selectable in addition to these two protocols. The standard can make provision for the Ethernet protocol and/or the HDLC protocol to be used on one or more protocol layers.

It is advantageous if the first unit and the second unit are in each case an entity for baseband processing of radio signals. The baseband processing in the send direction can include e.g. the encoding, spreading, scrambling and block forming. In the receive direction, e.g. channel estimation and the respective reverse operations to those of the send

direction can be carried out in the context of the baseband processing.

According to a configuration of the invention, the first unit has means for processing data, which was received via the first interface, of the second unit. Consequently, the first unit can combine its own data with data of the second unit before said data is transferred to the third unit via the second interface.

In a development of the invention, the third unit is a send and/or receive entity for sending and/or receiving radio signals. The third unit preferably receives such radio signals or content of said radio signals from the first unit, which can be implemented in the form of an entity for baseband processing of radio signals. Correspondingly, it is possible for the third unit to transfer such radio signals to the first unit, which can be implemented in the form of an entity for baseband processing of radio signals. The third unit can have antennas for receiving and/or transmitting radio signals.

It is advantageous if the claimed device represents at least one component of a base station in a radio communication system.

In a development of the invention, the first and the second interface are an interface which is specified according to the CPRI standard. The CPRI standard is understood to mean both the current valid version and future versions.

In the method for operating a device comprising at least one first unit, data is transferred between the first unit and a second unit which is functionally identical to the first unit via a first interface, and between the first unit and a third

unit which is functionally different from the first unit via a second interface. A plurality of different data types are transferred via the first and the second interface in each case, and the first and the second interface are specified according to the same standard.

The above configurations and developments relating to the standard and/or the first unit and/or the second unit and/or the third unit can be applied correspondingly with reference to the claimed method.

The invention is explained in greater detail below with reference to an exemplary embodiment, in which:

Figure 1 shows a section of a base station according to the invention;

Figure 2 shows a section of a base station according to the prior art.

The invention is explained below with reference to a base station of a UMTS radio communication system, in which base station a CPRI (Common Public Radio Interface) interface is used. However, the invention is not restricted to base stations or to the use of CPRI interfaces and therefore according to the invention a different standard interface, via which a plurality of different data types can be transferred, can also be used instead of a CPRI interface in a base station or another device.

The CPRI interface utilizes an electrical and/or optical transfer method on the physical layer. Various data types are transferred via the CPRI interface using a time-division multiplexing method. As a transfer protocol for the second

layer in the case of the CPRI interface, it is possible to use inter alia part of the Ethernet protocol and/or an HDLC (High Data Link Control) protocol and/or operator-specific transfer protocols which might vary from interface to interface e.g. depending on the entities which are connected by the interfaces concerned. The CPRI interface is described in the currently valid standard version CPRI Specification V1.0, the content of which is referred to here and which belongs to the disclosure of the application.

In the case of base stations in radio communication systems, functionally different elements are divided into blocks. This modular structure allows the independent scalability of the functionally different elements, such that there normally exists a different number of blocks of elements having various functions. Such a division of a base station according to the prior art is shown schematically in Figure 2. The baseband processing of subscriber data takes place in two types of modules. A module KONZ is connected in star form to the three modules CHC1, CHC2, CHC3 (CHC: Channel Card), for example. In the send direction the channel encoding takes place in the modules CHC1, CHC2 and CHC3, and the spreading and scrambling and the addition of baseband subscriber station data of various subscribers takes place in the KONZ module. In the receive direction the channel estimation, demodulation and decoding take place in the modules CHC1, CHC2 and CHC3.

The module KONZ is connected to a send/receive unit RE, to which it transfers subscriber station data that is to be sent and comes from the modules CHC1, CHC2 and CHC3, or from which it receives subscriber station data that has been sent by subscriber stations. In a UMTS radio communication system, if subscriber station data of a plurality of subscriber stations is transmitted on a radio frequency or on a radio frequency

band via a send/receive unit RE, which data was processed by various of the modules CHC1, CHC2 and CHC3, an addition of this subscriber station data which was received from the modules CHC1, CHC2 and CHC3 takes place in the module KONZ. Similarly, the module KONZ distributes the subscriber station data received by the send/receive unit RE to all modules CHC1, CHC2 and CHC3 which carry out the baseband processing of subscriber station data of the frequency concerned. A connection between the functionally identical modules CHC1, CHC2 and CHC3 does not exist.

Two baseband processing entities BB1 and BB2 are illustrated in Figure 1. Each of the two baseband processing entities BB1 and BB2 is preferably an element representing a combination of the two elements CHC and KONZ illustrated in Figure 2. Consequently, all of the baseband processing which is divided onto two elements according to the prior art as illustrated in Figure 2 takes place in one such baseband processing entity BB1 or BB2. In this case, each baseband processing entity BB1 and BB2 of a base station is connected to a shared control unit which is connected to an RNC (Radio Network Controller) via the interface which is designated as $Iu_b$ in UMTS. However, the baseband processing entities BB1 and BB2 can also be designated as REC (Radio Equipment Controller) units according to the CPRI specification, said units being connected to the RNC via the $Iu_b$ interface in each case. In the first of the two described cases, a unit REC consists of a plurality of baseband processing entities BB1 and BB2.

The subscriber station data is transmitted to or received from the subscriber stations by the send/receive units RE1 and RE2. In UMTS, the send/receive units RE1 and RE2 are connected via radio to the subscriber stations via the interface which is designated as Uu. Each send/receive unit RE1 or RE2 is

responsible for the transmission of radio signals on a radio frequency or in a frequency band and/or in a sector. The two baseband processing entities BB1 and BB2 are connected to the send/receive units RE1 and RE2 via an interface CPRI2 of the type CPRI. Differing from the illustration in Figure 1, it is additionally or alternatively also possible for the baseband processing entity BB1 to be connected to the send/receive unit RE2 and the baseband processing entity BB2 to be connected to the send/receive unit RE1 via the same interface CPRI2 of the type CPRI.

Various types of data are transferred via the interfaces CPRI2 in a downlink direction, i.e. from the baseband processing entities BB1 or BB2 to the send/receive units RE1 or RE2:

- subscriber station data in the form of IQ data, i.e. digital payload and/or signaling data which undergoes baseband processing and must be transmitted to subscriber stations,
- control data for controlling the send/receive units RE1 and RE2,
- synchronization data for synchronizing the send/receive units RE1 and RE2.

In a receive direction, subscriber station data which is received by the send/receive units RE1 and RE2 is transferred via the interfaces CPRI2 to the baseband processing entities BB1 and BB2 for further processing.

According to the invention, an interface CPRI1 of the type CPRI is also used for connecting the two functionally identical baseband processing entities BB1 and BB2. Corresponding sub-units of the baseband processing entities BB1 and BB2 can thereby communicate directly with each other. The following types of data are transferred:

- subscriber station data in the form of IQ data which must be transmitted to or has been received from subscriber stations,
- data which is received from the RNC and/or OMC (Operation and Maintenance Center), e.g. in the form of subscriber station data and in the form of control data relating to the operation and/or maintenance of the baseband processing entities BB1 or BB2,
- control/maintenance data which does not come from the RNC or OMC and is used for configuring the interface CPRI1 between the baseband processing entities BB1 and BB2, e.g. the information about which subscriber station data is exchanged between the baseband processing entities BB1 and BB2,
- synchronization data for synchronization between the baseband processing entities BB1 and BB2.

Consequently, the identically defined CPRI interface in the base station is utilized for two different types of connection, on one hand for the connection between the functionally different baseband processing entities BB1 or BB2 and the send/receive units RE1 or RE2, and on the other hand for the connection between the functionally identical baseband processing entities BB1 and BB2. Consequently, the same transfer methods on the physical layer and the same transfer protocols of the second layer are available for the communication between the baseband processing entities BB1 or BB2 and the send/receive units RE1 or RE2 on one hand and between the baseband processing entities BB1 and BB2 on the other. Therefore the subscriber station data can be transferred between the baseband processing entities BB1 and BB2 using the same transfer protocols as are used for the subscriber station data between the baseband processing

entities BB1 or BB2 and the send/receive units RE1 or RE2. According to its content, the data which is received from the RNC and exchanged between the baseband processing entities BB1 and BB2 can be transferred using the same transfer protocols as are used for the subscriber station data or the control data between the baseband processing entities BB1 or BB2 and the send/receive units RE1 or RE2. The control and maintenance data which does not come from the RNC can be transferred between the baseband processing entities BB1 and BB2 using the same transfer protocol as is used for the control data between the baseband processing entities BB1 or BB2 and the send/receive units RE1 or RE2. Finally, for the synchronization data for synchronization between the baseband processing entities BB1 and BB2, it is possible to use the same transfer protocols as are used for sending the synchronization data from the baseband processing entities BB1 and BB2 to the send/receive units RE1 or RE2 for the purpose of synchronizing the send/receive units RE1 and RE2.

Even if there are more baseband processing entities, two baseband processing entities are connected together via a CPRI interface in each case, wherein all baseband processing entities except for two are connected to two further baseband processing entities in each case, such that a continuous connection consisting of a plurality of paired connections exists between all baseband processing entities. Consequently, unrestricted scalability of the hardware of the base station is possible. It is therefore possible if required to add an additional baseband processing entity which is connected via a CPRI interface e.g. to the most recently added baseband processing entity that has only one connection to another baseband processing entity. Such scalability is not normally possible in the case of star-form connection structures as illustrated in Figure 2, for example, and therefore a maximal

number of added baseband processing entities often exists in accordance with the prior art.

If a baseband processing entity BB1 or BB2 as per Figure 1 consists in each case of a module CHC and KONZ as per Figure 2, the connection of the baseband processing entities BB1 and BB2 as per Figure 2 allows a reduction in the number of modules required per base station due to the omission of the independent module KONZ. Since the maintenance costs for base stations usually increases according to the number of modules used, the use of an interface between the functionally identical baseband processing entities results in a cost reduction in the operation of base stations.

The use of the interface CPRI1 between the baseband processing entities BB1 and BB2 allows the addition of the subscriber station data of a frequency band before sending, either by transferring the subscriber station data of the baseband processing entity BB1 via the interface CPRI1 to the baseband processing entity BB2 or vice versa. The baseband processing entity BB1 or BB2 which has carried out the addition then passes the added subscriber station data via the interface CPRI2 to the send/receive unit RE1 or RE2 which is responsible for the relevant frequency.

With reference to the receive direction, the connection of the two baseband processing entities BB1 and BB2 via the interface CPRI1 is particularly advantageous if the two send/receive units RE1 and RE2 each serve different sectors using the same radio frequency. If both send/receive units RE1 and RE2 receive subscriber station data of a subscriber station, they pass it to the respectively connected baseband processing entities BB1 and BB2 via the interface CPRI2. The subscriber station data is forwarded to the other baseband processing

entity BB1 or BB2 respectively via the interface CPRI1 between the baseband processing entities BB1 and BB2. It is thereby possible to combine the subscriber station data which is received via different sectors in order thus to increase the quality of the received subscriber station data.

Use of the interface CPRI1 is also advantageous for connecting the baseband processing entities BB1 and BB2 if the two baseband processing entities BB1 and BB2 belong to different network operators. If a first network operator owns a license for a first frequency band and a second network operator owns a license for a second frequency band, for example, the two network operators can share the send/receive units RE1 and RE2 (site sharing or antenna sharing), wherein the first send/receive unit RE1 is used for both frequencies and a first sector, while the second send/receive unit RE2 is used for both frequencies and a second sector. The remaining entities on the network side belong to only one of the network operators in each case, wherein each of the two network operators owns baseband processing entities solely for the frequency which it has licensed. The baseband processing entity B1 of the first operator is connected to the first send/receive unit RE1 and the baseband processing entity B2 of the second operator is connected to the second send/receive unit RE2. The subscriber station data for various subscriber stations, which data is to be sent on the first or the second frequency, is passed to the other baseband processing entity in each case using the interface CPRI1 before it is sent, such that subscriber station data of a frequency can be transmitted concurrently or consecutively in different sectors. The same applies correspondingly to the processing of the subscriber station data of a frequency, which data is received in different sectors.

The described multiple use of the same standard interface for connecting both functionally identical and functionally different modules allows a device to be implemented inexpensively since the interface can be produced in larger unit volumes, thereby reducing manufacturing costs. Furthermore, the same software can be used for the functionally identical and the functionally different modules, thereby reducing the development costs of the software.

The described procedure can be applied analogously in the case of more than two baseband processing entities BB1 and BB2. In this case, each baseband processing entity is connected in each case to one or two other baseband processing entities and to one or more send/receive units. It is also possible to intermesh the baseband processing entities with each other, such that if there are three baseband processing entities, for example, each baseband processing entity is connected to both of the other baseband processing entities. In general, each baseband processing entity can be connected to any number of other baseband processing entities.

Patent claims

1. A device comprising at least one first unit (BB1, BB2),
   - having a first interface (CPRI1) for transferring data between the first unit (BB1, BB2) and a second unit (BB1, BB2) which is functionally identical to the first unit (BB1, BB2),
   - having a second interface (CPRI2) for transferring data between the first unit (BB1, BB2) and a third unit (RE1, RE2) which is functionally different from the first unit (BB1, BB2),

   characterized in that
   - the first and the second interfaces (CPRI1, CPRI2) are configured such that
     - a plurality of different data types can be transferred in each case, and
     - they are specified according to the same standard,
   - the first unit (BB1, BB2) and the second unit (BB1, BB2) are in each case an entity for the baseband processing of radio signals, and
   - the device represents at least one component of a base station of a radio communication system.

2. The device as claimed in Claim 1, in which the standard provides for the transfer of the different data types using a time-division multiplexing method.

3. The device as claimed in Claim 1 or 2, in which the standard can provide for an optical and/or an electronic transfer method.

4. The device as claimed in one of the Claims 1 to 3, in which
the standard provides for an Ethernet protocol and/or an HDLC protocol as a transfer protocol.

5. The device as claimed in one of the Claims 1 to 4, in which
the first unit (BB1, BB2) has means for processing data, which was received via the first interface (CPRI1), of the second unit (BB1, BB2).

6. The device as claimed in one of the Claims 1 to 5, wherein
the third unit (RE1, RE2) is a send and/or receive entity for sending and/or receiving radio signals.

7. The device as claimed in one of the Claims 1 to 6, in which
the first and the second interfaces (CPRI1, CPRI2) represent an interface which is specified according to the CPRI standard.

8. A method for operating a device comprising at least one first unit (BB1, BB2), in which

- data is transferred between the first unit (BB1, BB2) and a second unit (BB1, BB2) which is functionally identical to the first unit (BB1, BB2) via a first interface (CPRI1),
- data is transferred between the first unit (BB1, BB2) and a third unit (RE1, RE2) which is functionally different from the first unit (BB1, BB2) via a second interface (CPRI2),

characterized in that

- a plurality of different data types are transferred via the first and the second interface (CPRI1, CPRI2) in each case, and
- the first and the second interface (CPRI1, CPRI2) are specified according to the same standard, and
- the first unit (BB1, BB2) and the second unit (BB1, BB2) are in each case an entity for the baseband processing of radio signals, and
- the device represents at least one component of a base station of a radio communication system.

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FIG 1

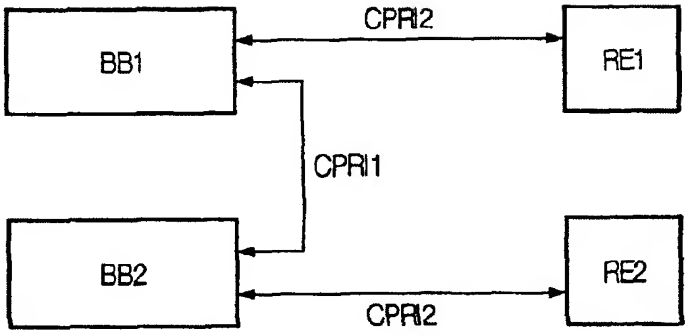


FIG 2
Prior art